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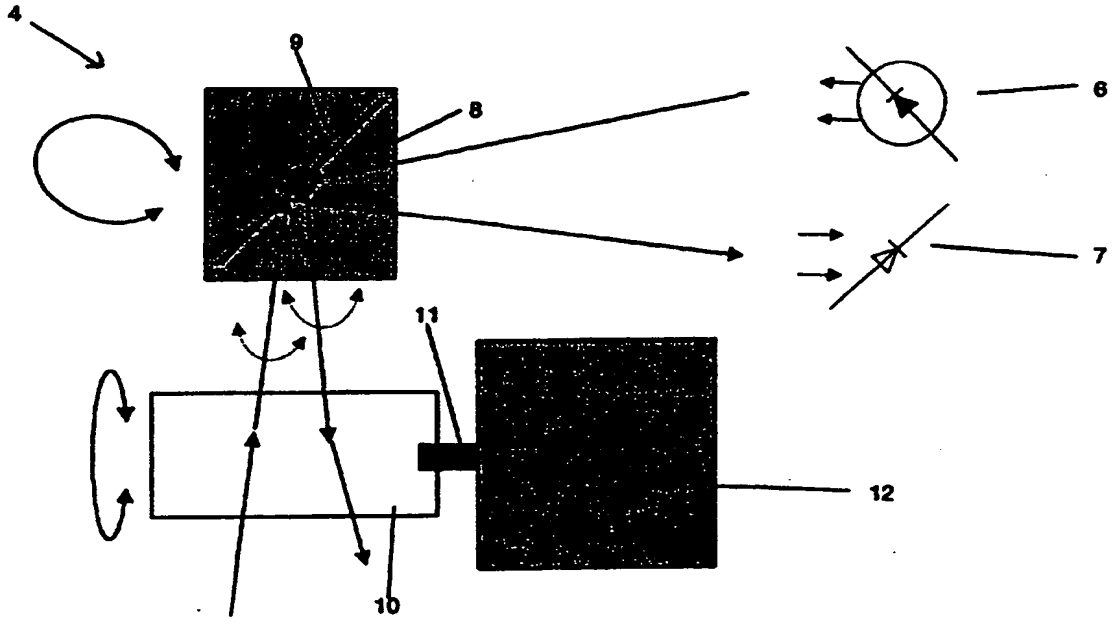

(57) Abstract

The invention concerns a method and a device for digitizing coordinates and/or images. According to the invention, the position of a mouse (5) on a lightbox (2) is determined by detecting two light detectors (16) on the mouse with a light beam directed from a light source above the lightbox via mirrors (8, 10).

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A Device and a Method for Digitizing Coordinates and/or an Image

This invention concerns a device and a method for digitizing coordinates and/or an image and more precisely a device and method by means of which the digitizing of an image can be performed free of the numerous drawbacks that pertain to the equipment presently in use.

The digitizing of coordinates and images has been known for a long time, and many applications have been used for this purpose. Among the basic types is an electromagnetic digitizing system in which wires are placed, for the purpose of electromagnetic determination of coordinates, across a digitizing table at certain intervals. The wires are and remain as physical objects which are visible under an x-ray film, for example, when the film is viewed on a digitizing table. When the film is digitized, the presence of the wires causes an obvious deterioration in quality. Attempts have been made to eliminate this drawback by using opaque covering glass and side illumination to fade out the wires. The problem of light directed from the side, however, is that it does not illuminate large areas uniformly.

Furthermore, the digitizer of the above-mentioned system is complicated in structure, as well as heavy and expensive. An additional restriction on the structure is that it should not be used, according to the recommendations of the manufacturers, near large metal objects. However, the digitizing table is just that kind of large metal object which may disturb its use.

Another device commonly used in this field is the video digitizer, the main weakness of which is that it has not been possible to develop its resolution to meet the precision standards set for modern equipment.

Another type of device used especially for the digitizing of x-ray films comprises a film transporting mechanism and a scanning device which illuminates the film from one side and scans it, on the line number principle, from the other side. The device in question contains a sensitive film transporting mechanism and

entirely lacks the possibility to digitize the coordinates in a memory. In addition, the equipment is very expensive.

The purpose of this invention is to solve all the above-mentioned problems and achieve a method and a device for digitizing coordinates and images in such a way that eliminates the use of wires or other additional parts that lower the image quality. A further purpose of the invention is to achieve a device and a method which can be made simply and economically, requiring neither digitizing tablets nor a massive digitizing table, and with which the expansion of the scanning area is entirely possible. A further advantage that can be mentioned is that, in accordance with the invention, it is possible to achieve a very simple and new kind of structure for scanning film.

The above-mentioned and other benefits and advantages of the invention are achieved by a method and a device whose characteristic features are presented in the attached claims.

The invention is described in more detail in what follows with reference to the attached drawings in which

Figure 1 shows, in simplified form, a side view of one embodiment of the invention,

Figure 2 shows the working principle of a device according to the invention, including a searching/reading light signal from a light source/to a light detector and an example of a search path, and

Figure 3 shows the pointing device to be used in the invention and the determination of coordinates with its aid.

Figure 1, then, presents a simplified overall view of the device 1 according to the invention. Device 1 comprises mainly the following parts. The light box 2 can be located on any suitable base whatsoever, such as the surface of a table. It comprises, as is normal, a transparent or translucent surface plate, under

which is a light source. The object to be digitized, such as an x-ray film, is placed on the lightbox 2, whereupon it is illuminated from below and the light transparency of its various parts is measured, as is later explained.

Attached to lightbox 2 is a support arm 3 which can be of any type whatsoever, but conceals within it, for example, the necessary cables and accessories needed for the devices located schematically in part 4 of the diagram. Part 4 comprises a suitable light source, such as an infrared light source, which, by means of suitable scanner optics and moving mechanisms, produces a light beam which, according to the invention, scans the lightbox in a search for the optical detectors located in mouse pointer 5 placed on top of the lightbox.

In short, the positioning of the coordinates is based on the principle that the light beam emitted from the light source searches for the optical detectors of the mouse pointer 5, and that once their position has been established, the exact position of the mouse pointer can be deduced.

According to a preferred embodiment of the system according to the invention, the part marked by reference number 4 generally contains an optical sensor, capable of precisely measuring the light intensities coming through a film or the like placed upon a lightbox, by means of a system, for example, in which the optical detector receives the light to be measured via mirrors. The use of light reflected from mirrors has the advantage that there already exist essentially ready systems for moving mirrors precisely and for scanning the area to be examined by moving the mirrors.

The following is one of the practical applications that may be mentioned. Using a device according to the invention, an x-ray film placed on lightbox 2 may be digitized in the memory of a suitable information system, and in particular so that films scanned simultaneously from several directions are used, whence it is possible to form a three-dimensional image.

For example, for the purposes of certain kinds of radiotherapy, catheters and other instruments intended for treatment may have been inserted in a person

from whom such images are taken. The exact positions of these instruments is important to the treatment plan. Therefore, after the image is read into the memory, the position of the said instruments is entered into the same memory system by pointing the mouse pointer at the desired point and pressing the mouse user button to transfer the coordinates to the memory. Obviously, the light beam from part 4 monitors the position of the mouse's detectors the whole time, so that the coordinates are constantly recorded.

Figure 2 shows, in more detail and by way of example, a certain application of the mirror system contained in part 4. Thus, part 4 contains a light source 6 which may, for example, be a source of infrared light such as a light-emitting diode (LED). Part 4 additionally contains a light detector 7 which may also be a diode in type, i.e. a light-sensitive diode. The light beam transmitted by the light source 6 first hits the mirror 8 which rotates under precise and high speed control around its axle 9. This mirror 8 carries out the scanning in one direction, the X direction. A second mirror 10 is located so that, while rotating around its axle 11, it carries out scanning in the opposite direction, the Y direction. The search path of the light beam is presented schematically in the left margin of figure 2. Clearly, the search path is denser in practice than that shown here. The device used to rotate the mirror 10 is marked by the reference number 12.

Exactly the same mirror systems are used when the image is scanned into the computer's memory. In this case, the light intensities penetrating the film on top of lightbox 2 are measured by light detector 7 after being reflected from mirrors 10, 8. The scanning path may be, and will preferably be, the same as is presented in the foregoing.

Figure 3 shows one example of how locating the coordinates of the mouse pointer 5, which is placed on the lightbox to give the exact coordinates of a desired point, occurs according to one preferred method. Thus, the mouse pointer 5 contains, as is normal, the user buttons 13 for giving control commands to the system. At the same time, it has a pointing part 14 equipped with suitable cross-hairs 15 to facilitate the pinpointing of an exact position at the cross point of the cross-hairs 15. However, the mouse pointer 5 also has two light detectors

16, the purpose of which is to determine the coordinates of the mouse location by detecting the searching light coming from the light source 6.

The location of both light detectors 16 is determined in order to clarify the position of the mouse pointer 5, including those cases when it is not at right angles to the area to be scanned. In accordance with a certain preferred embodiment of the invention, the exact determination of the coordinates is carried out as follows. It may be seen in the lower part of figure 3 that the light beam identifies the position of both light detectors by sweeping over them in two orthogonal orientations in both directions. As is shown at the bottom of figure 3, there is a rising signal at the point where the light beam hits the light detector 16. The light beam coming from the opposite direction fixes the location of the other edge of the detector 16. The exact coordinates are gained from the average of the rising slopes of the detector signals, and there is thus no need to define the centre points of the detectors. Nor does the measuring radius or the radius of the light detectors need to be especially small.

All the available information is transferred by a suitable transfer system, such as standard cables, to a computer containing a suitable programme for the storing and processing of such information.

Naturally, a suitable control system is required for the operation of a system according to the invention. Such technical details are self-evident to professionals in the field and thus need no detailed description here. In addition to the software and hardware required for the control itself, the control system also normally needs components with which to eliminate a range of possible errors including misalignments of the optical scanner, mechanical errors and various errors related to the detectors and sensors.

As is apparent from the foregoing, the structure of a device according to the invention is extremely simple and operationally reliable. Thus, the device is also economical in terms of its manufacturing costs. The device is totally free of those drawbacks of electromagnetic equipment that relate specifically to the use of magnetism. Thus, a device according to the invention may be located in the

immediate vicinity of large metal objects, if the need arises. It has been proved that use of a device according to the invention allows a level of precision comparable to that of any known equipment whatsoever developed for a similar purpose, and that its speed is also in the same class as the best equipment on the market.

It is clear that the foregoing invention has been described in only its main features and in simplified form. Thus the invention can be adapted in many ways without departing from the protective sphere defined by the attached claims. Although the foregoing refers, for example, to the use of infrared light, there is nothing to prevent the use of other types of light for purposes according to the invention, even though infrared light is the most probable option.

It is also entirely possible to use only one mirror instead of two, or a system in which the light beam is controlled by other devices which reflect or deflect it, such as a prism or the like. The essential point, however, is that it is possible to move the light beam in two directions.

Claims

1. A device for digitizing coordinates into the memory of a storage device, comprising a mouse-pointer (5) resting on a base (2) and designed to show the point whose coordinates are desired, **characterised** in that the device comprises a light source (6) in the area above the base, reflective and/or deflective control instruments (8, 10) for orienting the light beam, and light detectors (16) in the mouse-pointer (5) for detecting the light beam.

2. A device according to claim 1, **characterised** in that the instruments for reflecting/deflecting light are mirrors (8, 10), prisms or the like.

3. A device according to claim 2, **characterised** in that the instruments are mirrors, of which there are two, one of which (8) moves the light beam in one direction while the other (10) moves the light beam in the orthogonal direction.

4. A device according to claim 3, **characterised** in that the mirrors (8, 10) oscillate in opposite directions around their axles or rotate around their axles.

5. A device according to claim 1, **characterised** in that it also contains a light detector (7) for digitizing the image into the memory of a storage device by measuring the amount of light penetrating an image with a detector (7) using light-reflective and/or deflective instruments (8, 10) according to claim 1.

6. A device according to any of the foregoing claims, **characterised** in that the light source (6) is a light-emitting diode and the light detector (7) is a light-sensitive diode.

7. A device according to any of the foregoing claims, **characterised** in that the mouse-pointer (5) has two light detectors (16), a pointer (5), and cross-hairs or the like for determining the position of a point in two directions.

8. A method for digitizing coordinates into the memory of a storage device by using a device having a mouse-pointer (5) resting on a base (2) and designed to show the point whose coordinates are desired, **characterised** in that a light beam is transmitted from a light source in the area above the base (2) via reflective and/or deflective control instruments (8, 10) in order to detect the light beam of the light detectors (16) located in the mouse-pointer (5).

9. A method according to claim 8, **characterised** in that the light beam is moved in the search for the light detectors (16) from one border of a search area to the other, in the desired density of sweeps.

10. A method according to claim 8, **characterised** in that it also includes a stage when the intensity of light coming from the base (2) and penetrating a film on top of the base (2) is measured via the control instruments (8, 10) with the light detectors (7) for the purpose of digitizing the film.

11. A method according to claim 8, **characterised** in that the search for the light detectors (16) in the mouse-pointer (5) is carried out in two orthogonal orientations in both directions and that the average of the rises in the observed signals, read from opposing directions, determines the position of the coordinates.

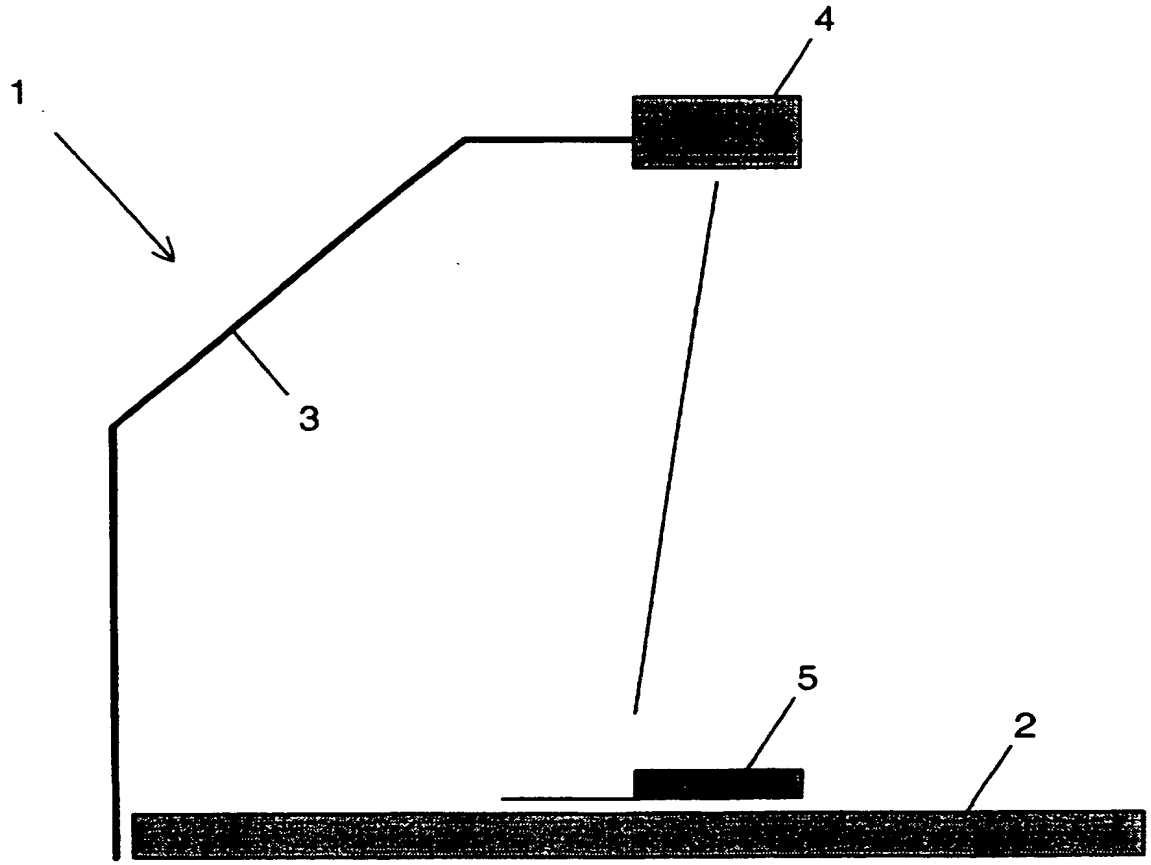

Fig. 1

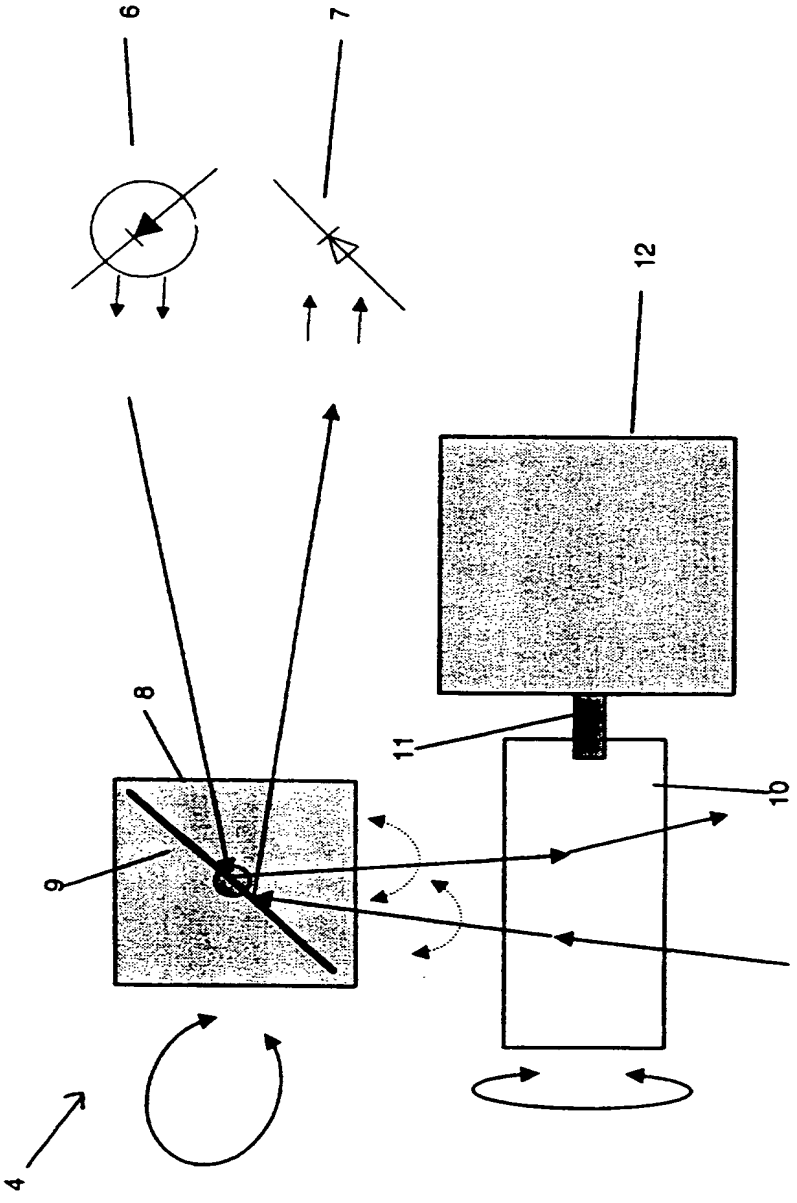

Fig. 2

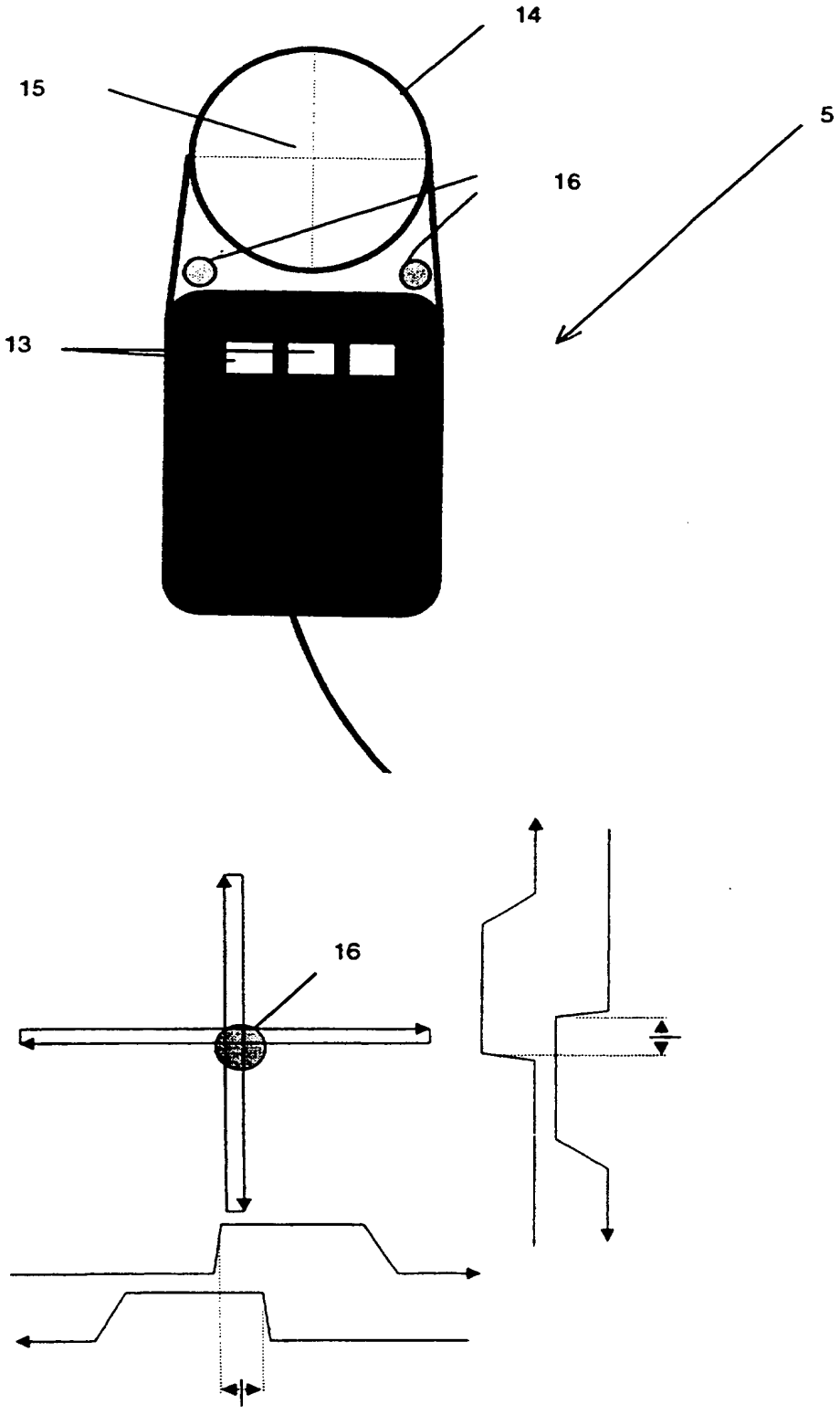

Fig. 3

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G06F 3/033, G06K 11/08, G06K 11/18
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5073770 A (H.G. LOWBNER), 17 December 1991 (17.12.91), column 1, line 23 - line 45 --	1-11
A	US 4550250 A (W.A. MUELLER ET AL), 29 October 1985 (29.10.85), column 3, line 3 - line 27, figure 1 --	1-11
A	US 3613066 A (C.R. COOREMAN), 12 October 1971 (12.10.71), abstract --	1-11
A	GB 1466471 A (CETEC SYSTEMS LIMITED), 9 March 1977 (09.03.77), page 1, line 10 - line 59, figure 1 --	1-11

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5287105 A (D.L. SCHLOTTERBECK ET AL), 15 February 1994 (15.02.94), figure 2, abstract -- --------	7

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI 96/00481

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5073770	17/12/91	US-A- 4949079	14/08/90
		US-A- 5159322	27/10/92
US-A- 4550250	29/10/85	NONE	
US-A- 3613066	12/10/71	NONE	
GB-A- 1466471	09/03/77	NONE	
US-A- 5287105	15/02/94	NONE	